# Space Weather Technical Forecast

Issued on Thursday, 28 October 2021 at 13:14 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

**Space Weather Forecast Headline: Moderate Solar Activity with further M-flares/R1 Radio Blackouts possible.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar Activity is Moderate, with two M-flares from AR2887 Dac/Beta-Gamma-Delta in the last 24 hours, M1.4 at 28/0740 UTC and M2.2 at 28/1028 UTC. This is a moderately sized complex and evolving region in the southern central disc. AR2891 Dai/Beta in the northeast has remained fairly inactive in the last 24 hours, despite its history of M-flaring. AR2889 Bxo/Beta in the southeast and AR2890 Bxo/Beta in the southwest have continued to gradually decay, whilst AR2886 Hsx/alpha has persisted as an inactive and mature feature. A filament eruption was observed from the vicinity of AR2887 at 27/2300 UTC, but an associated CME has not been identified in available imagery. No other Earth-directed CMEs have been observed.

**Solar Wind / Geomagnetic Activity:** The solar wind speed, as measured by DSCOVR at L1 was at background levels, declining from 400 km/s to near 300 km/s. The density was at or below average, rising to near 10 ppcc. The strength of the interplanetary magnetic field (IMF), Bt, was weak persisting below 5 nT with the north-south component, Bz, ranging between +4 nT and -2 nT. The phi angle was predominantly within a negative sector (towards the Sun). Geomagnetic activity was Quiet throughout, Kp 0-1.

**Energetic Particles / Solar Radiation:** The high energy proton flux (greater than 10 MeV) as measured by GOES-16 was at background levels, with no solar radiation storms observed. High energy electron flux (greater than 2 MeV) was predominantly at background levels with the associated 24-hour electron fluence below the Active (1e8 integrated pfu) threshold with 1.58e6 integrated pfu recorded at 28/0000 UTC.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Solar Activity is forecast is forecast to be Moderate to Low with further M-class flares possible, primarily from AR2887 but potentially from AR2891.

**Solar Wind / Geomagnetic Activity:** A glancing impact from a passing CME is possible late day 3 (30th) or early day 4 (31st). This originated from a filament eruption around 26/2000 UTC, but low confidence. No other CMEs are currently expected to arrive at Earth. There are no notable coronal holes on the visible disc that could bring fast wind influence through the period, with solar winds expected to remain mostly at background. Mainly quiet Geomagnetic activity is forecast, with a slight chance of Unsettled intervals and a chance of Active intervals day 3 (30th) or day 4 (31st) from any CME arrival.

**Energetic Particles / Solar Radiation:** The high energy (greater than 10 MeV) proton flux is expected to remain below the S1-level, but with a slightly above background chance of increase flux, primarily from any significant flaring of AR2887. The high energy electron flux (greater than 2 MeV) is forecast to remain mostly at background, with the associated 24 hour fluence below the Active (1e8 integrated pfu) level.

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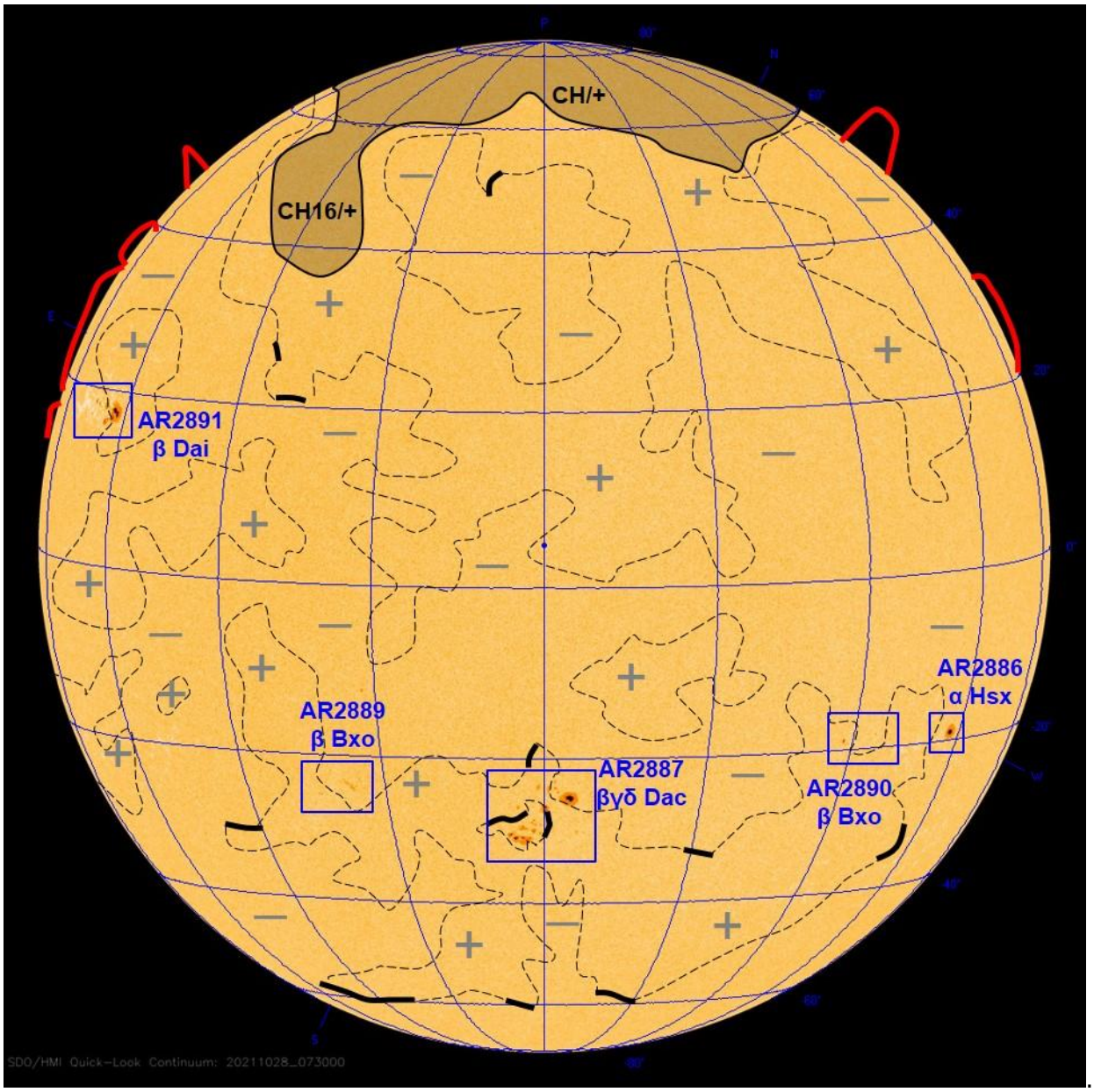
**Figure 1. Solar Analysis Valid 28/0800.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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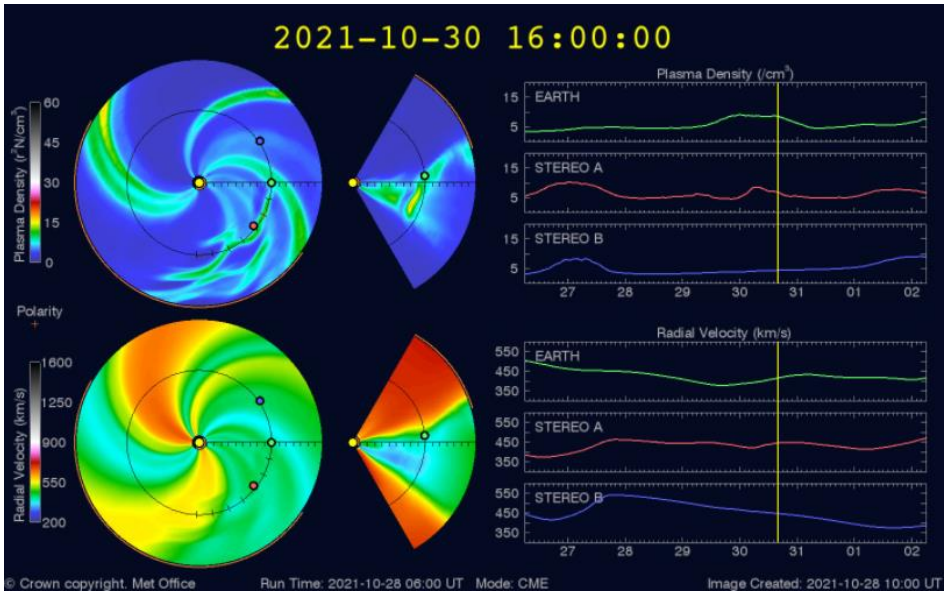
## Geomagnetic Storms:

There are no definitive Earth-directed CMEs, however a filament eruption that occurred on the 26/2000 UTC has the potential to give glancing effects on passing behind the Earth, most likely late on the 30th or early 31st. A further filament eruption occurred in the vicinity of AR2887 around 27/2300 UTC, but no visible CME in available imagery has currently been identified. No other Earth-directed CMEs have been observed.

Solar winds are currently at background. There are no coronal holes of interest for the forecast period on the visible disc, with no notable fast wind enhancements expected. Geomagnetic activity is forecast to be mainly Quiet, with a slight chance of Unsettled intervals throughout. There is chance of Active intervals late day 3 (30th) or day 4 (31st) from any glancing CME impact.

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 1 | 5 | 5 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

**Figure 2: ENLIL showing potential for glancing blow late on 30th.**

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## Radio Blackouts - X-Ray Flares:

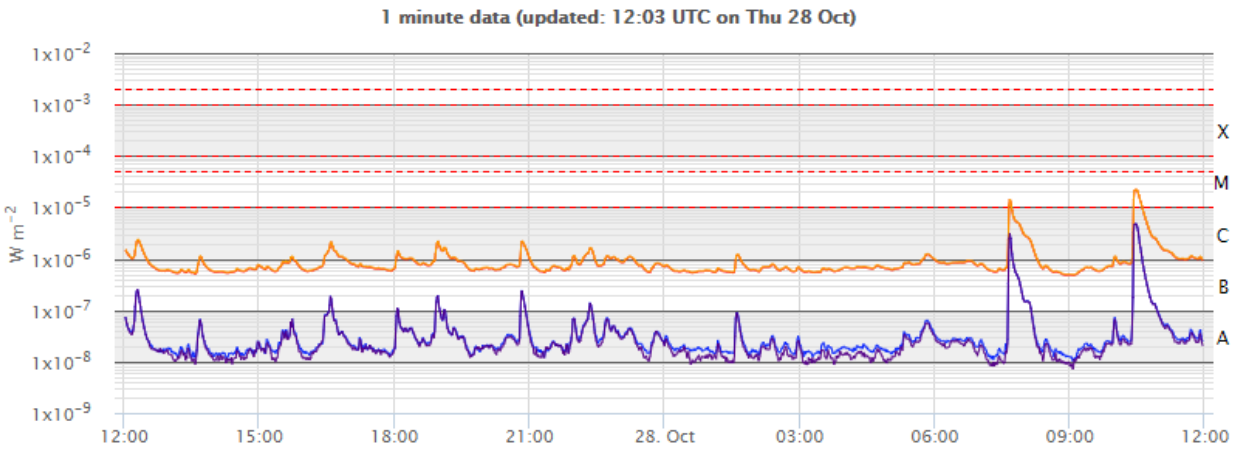
Solar activity is currently Moderate with 2 M-class flares (R1 Radio Blackouts) from AR2887 Dac/Beta-gamma-delta in the southern central disc. Further M-class flare activity is possible from this sunspot, which has an atypical and complex magnetic structure, with two notable negative spots but no large positive polarity spot. In the last 24 hours an intermediate region has developed penumbra, and there are two small delta spot regions (reverse polarities in the same penumbra) visible in SDO imagery.

AR2891 Dai/Beta in the northeast disc was a source of a number of M-flares as it rotated on the Earth-facing Sun. Despite this region easing to become less active in the last 24-48 hours, this also has the potential to produce M-class flare activity. There are three other regions on the visible disc, however these are all small and decaying (AR2889 Bxo/Beta, and AR2890 Bxo/Beta) or small, stable mature spots (AR2886 Hsx/alpha).

Solar Activity is expected to remain Moderate to Low, with a chance of further M-class flares.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | Yes | 60 | 50 | 40 | 40 |
| Very Active | R3 to R5 X Class | No | 5 | 5 | 2 | 2 |

**Figure 3: GOES-16/17 X-ray flux showing two M-flares**

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## Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background and expected to remain below the S1 level. There is a chance of flux levels rising however, primarily from any notable flaring of AR2887, and giving a slightly above background chance of reaching the S1 level.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 2 | 2 | 2 | 2 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

## High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16 at GEO is currently at background and expected to remain at this level through the period with no notable sources of enhancement. The associated 24 hour electron fluence is expected to remain at background levels, below the 1e8 integrated pfu threshold. This is supported by REFM, which is currently giving good guidance.

| GEO Electron Environment Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | No | 1 | 1 | 1 | 1 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 1 | 1 |

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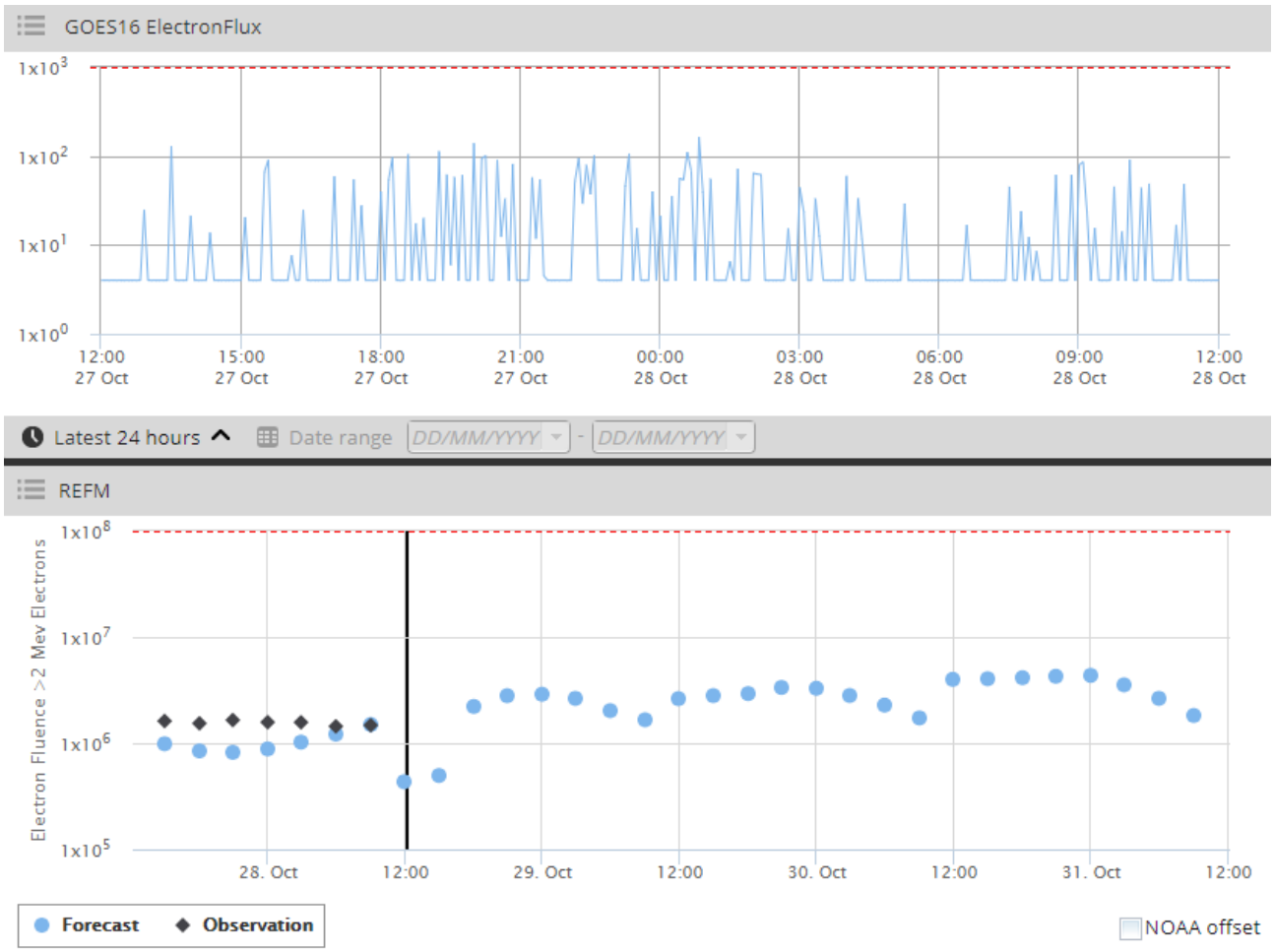
**Figure 4: >2 MeV GOES-16 Electron flux with associated fluence and REFM**

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